Innovation and High Performance Buildings

Facilities Maintenance and Hardware Acquisition Center Industry Event

February 29, 2012

Laurie Gilmer, P.E., CFM, SFP, LEED AP, CxA

Agenda

- Overview
- Regulations, requirements, and really good ideas
- Global perspective on emerging technologies
- Emerging technologies for the built environment
- Summary

The Building Context

The U.S. has 124.4 million residential and 4.9 million commercial buildings
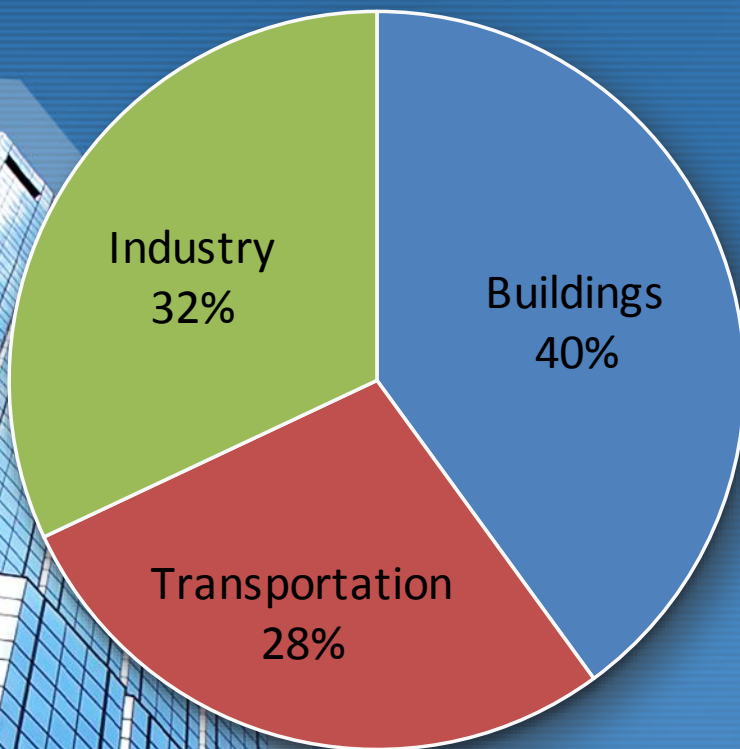
In 2008 these buildings accounted for:

- 40% Energy Consumed
  - 22% Residential
  - 18% Commercial
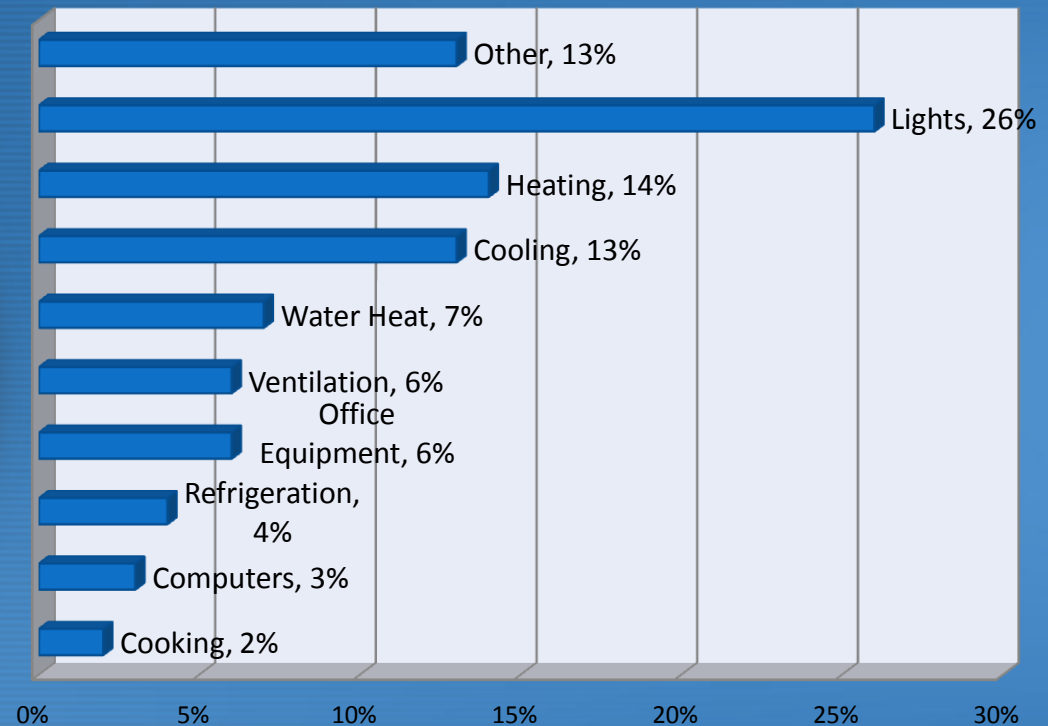- 39% CO_2 Emissions
- 9.7% Water (2005)

Greenhouse Gases
CO_2
CH_4
N_2O
HCFCs
PFCs
SF_6

Source: *2010 Buildings Energy Data Book*

Energy Use in the U.S.

Pie chart:
- Buildings 40%
- Transportation 28%
- Industry 32%

Commercial Buildings (18%)

Bar chart:
- Other, 13%
- Lights, 26%
- Heating, 14%
- Cooling, 13%
- Water Heat, 7%
- Ventilation, 6%
- Office Equipment, 6%
- Refrigeration, 4%
- Computers, 3%
- Cooking, 2%

(X-axis: 0%, 5%, 10%, 15%, 20%, 25%, 30%)
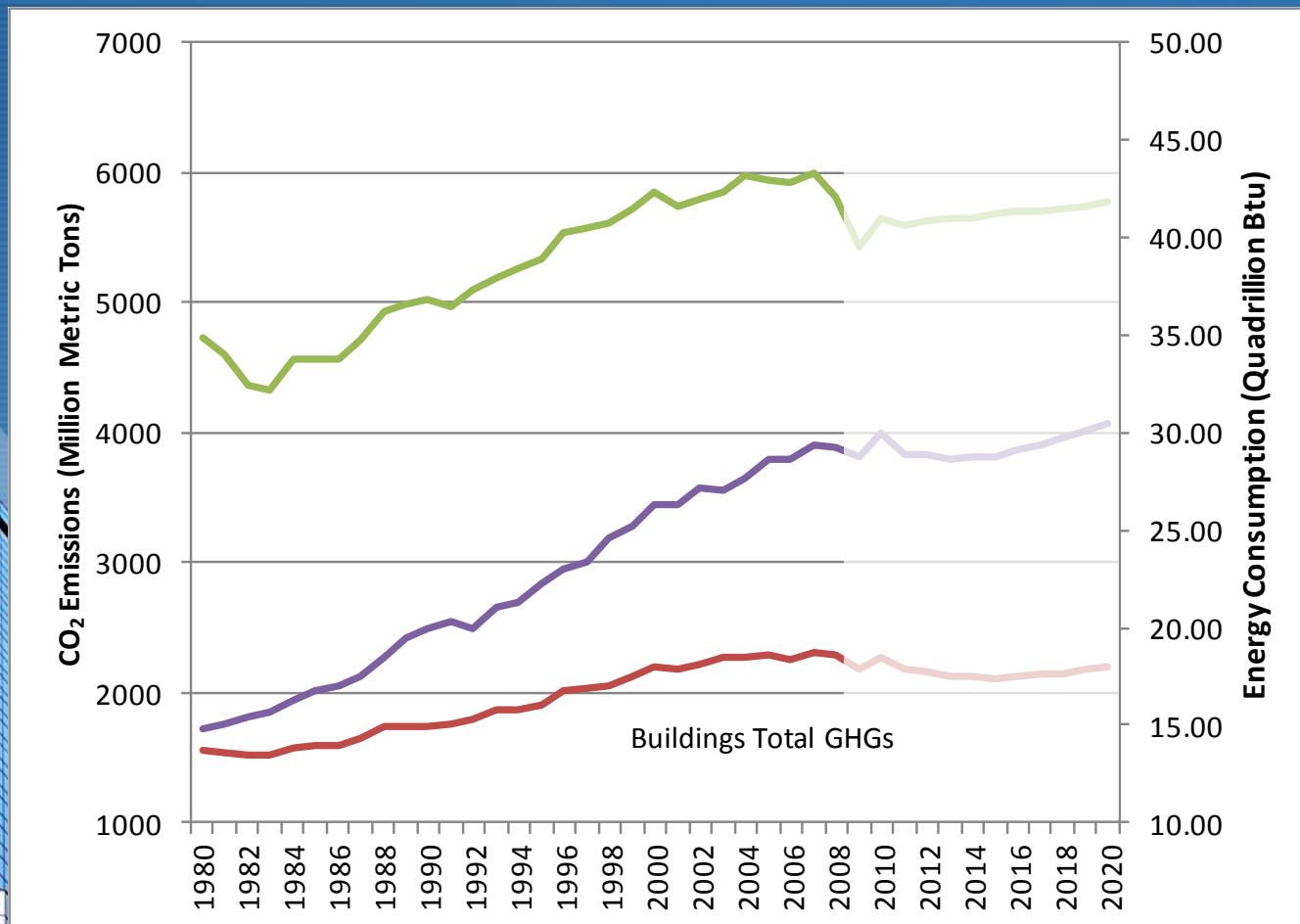
Data Source: 2007 DOE Building Energy Data Book

Energy and GHG Trends

IFMA Trend Reports

In 2007

1. Linking FM to Strategy
2. Emergency Preparedness
3. Change Management
4. **Sustainability**
5. **Emerging Technology**
6. Globalization
7. Broadening Diversity in the Workforce
8. **Aging Buildings**

IFMA Trend Reports

1. **Sustainability (↑ #4)**
2. **Complex Building Technology**
3. **Economic Recession & Aging Building Stock**
4. Preparedness
5. Quantity & Complexity of FM Data
6. Finding Top Talent
7. Elevating the FM Profession
8. Evolving Skill Set & Business Acumen
9. Enhancing Workplace Productivity
10. Changing Workplace

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The Future of Buildings

The Net-Zero & High Performance Buildings Vision

Enable design of new buildings and retrofits of existing buildings that over the life cycle:

- Produce as much energy as they consume and significantly reduce GHGs
- Double service life of building materials, products, and systems and minimize life cycle impacts
- Halve the use of domestic water (to 50 gal/day/person), maximize water recycling and rainwater harvesting, and minimize storm water runoff
- Achieve breakthrough improvements in indoor occupant health, productivity, and comfort

The Future of Buildings

"Transformational Advances" Needed

1. Develop the enabling measurement science to achieve net-zero energy, sustainable high-performance building technologies
2. Develop net-zero energy building technologies and strategies
3. Develop the scientific and technical bases for significant reductions in water use and improved rainwater retention.
4. Develop processes, protocols, and products for building materials that minimize resource utilization, waste, and life cycle environmental impacts.
5. Develop the knowledge and associated energy efficiency technologies and practices needed to promote occupant health, comfort, and productivity.
6. Enable technology transfer for net-zero energy, high-performance green buildings.

The Future of Buildings

The Net-Zero Energy Commercial Buildings Initiative

- 2030 - any commercial building constructed

- 2040 - 50% of U.S. commercial building stock
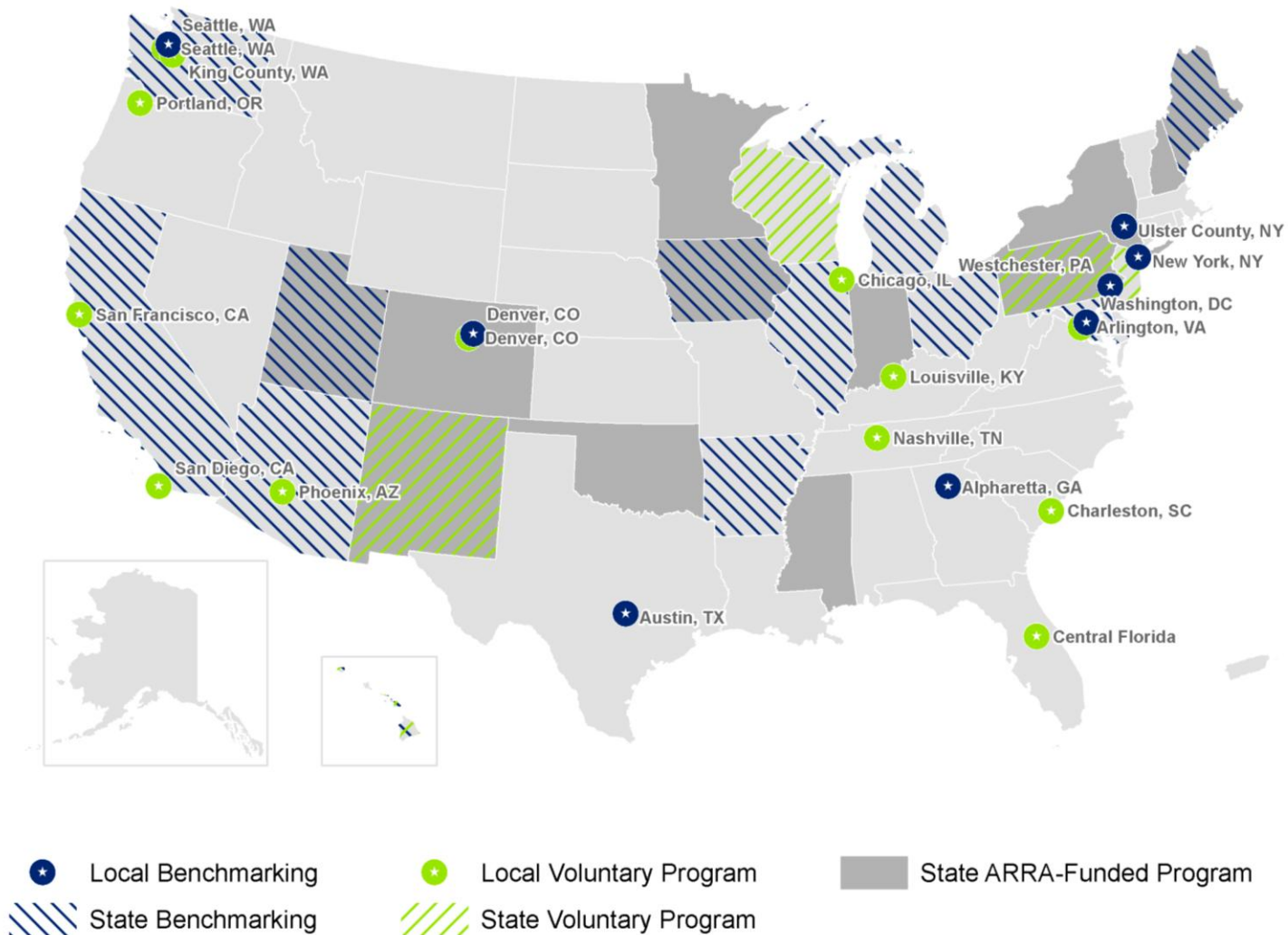
- 2050 - all commercial buildings

Federal Government Goals

	Regulation	Description	Goal
Energy	EO 13423 / EISA 2007	Reduce energy intensity	30% reduction by 2015
	EO 13423 / EPAct	Increase use of renewable energy	3% FY07-09 5% FY10-12 7.5% FY13+
GHG	EO 13514	Reduce Scope 1 & 2 emissions	21% by 2020
	EO 13514	Reduce Scope 3 emissions	6% by 2020

GSA Sustainability Plan Goals

Goals	Actions
Goal 1: Scope 1 &2 Greenhouse Gas Emissions Reductions	Decrease GHG reductions by 28.7% by FY20 from the FY08 baseline. Decrease energy consumption by FY15 30% from the FY03 baseline. Increase renewable energy production and procurement 30% by FY20.
Goal 2: Scope 3 Greenhouse Gas Emissions Reductions	Decrease GHG reductions by 43.9% from the FY08 baseline.
Goal 3: Develop & Maintain Agency Comprehensive Greenhouse Gas Inventory	Perform and maintain GHG inventory
Goal 4: High-Performance Green Buildings & Sustainable Design	Guiding Principles – By FY15, 18% of Existing Buildings & 100% of New Construction
Goal 9: Electronic Stewardship & Data Centers	100% of laptops, desktops, & monitors are compliant with ENERGY STAR power management settings. 100% of electronic

Industry Shift Toward Voluntary & Mandatory Performance Disclosure

Seattle, WA
Seattle, WA
King County, WA
Portland, OR
San Francisco, CA
San Diego, CA
Phoenix, AZ
Austin, TX
Denver, CO
Denver, CO
Chicago, IL
Louisville, KY
Nashville, TN
Alpharetta, GA
Charleston, SC
Central Florida
Ulster County, NY
New York, NY
Westchester, PA
Washington, DC
Arlington, VA

Local Benchmarking
State Benchmarking
Local Voluntary Program
State Voluntary Program
State ARRA-Funded Program

Source: ENERGY STAR

Government and Association Involvement

VOLUNTARY CAMPAIGNS AND PROGRAMS

Arlington, VA	Green Business Challenge
Central Florida	Central Florida Kilowatt Crackdown
Charleston, SC	Green Business Challenge
Chicago, IL	Chicago Green Office Challenge
Denver, CO	Watts to Water Challenge
Hawaii	Hawaii Clean Energy Initiative
Illinois	ComEd Automated Benchmarking
Louisville, KY	Louisville Kilowatt Crackdown
Nashville, TN	Green Business Challenge
New Jersey	New Jersey's Clean Energy Program, Pay for Performance, Local Government Energy Audit Program
New Mexico	Lieutenant Governor's ENERGY STAR School Challenge
Pennsylvania	Small Business Energy Efficiency Grants
Phoenix, AZ	BOMA Greater Phoenix Kilowatt Krackdown
Portland, OR	BOMA Portland Energy Showdown
San Diego, CA	Green Business Challenge
San Francisco, CA	Earth Hour 24x7 Energy Challenge
Seattle/King County, WA	BOMA Seattle Kilowatt Crackdown
Wisconsin	Lieutenant Governor's ENERGY STAR School Challenge

BENCHMARKING LEGISLATION AND POLICIES

Alpharetta, GA	Green Communities Ordinance
Austin, TX	ECAD Ordinance ✴
California	AB 1103 ✴
Denver, CO	Executive Order 123
Hawaii	House Bill 1464
Illinois	SB 3429
Michigan	Executive Order 2005-4, 2005
New York, NY	Greener Greater Buildings Plan ✴
New Mexico	NM SB 200
Ohio	Executive Order 2007-02
Seattle, WA	Ordinance 116721 ✴
Ulster County, NY	Government Energy Policy
Utah	Benchmarking all state-owned buildings.
Washington D.C.	Clean and Affordable Energy Act of 2008 ✴
Washington	SB 5854 - 2009-10 ✴

All listed locations have requirements for public sector buildings.
Those marked with a star (✴) also have private sector requirements

Source: ENERGY STAR

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Global Perspective

What will have the greatest impact in 2012?

1. Informatics for adding value to information
2. Synthetic biology and metabolic engineering
3. Green Revolution 2.0 - technologies for increased food and biomass
4. Nanoscale design of materials
5. Systems biology and computational modeling/simulation of chemical and biological systems
6. Utilization of carbon dioxide as a resource
7. Wireless power
8. High energy density power systems
9. Personalized medicine, nutrition and disease prevention
10. Enhanced education technology

- World Economic Forum Global Agenda Council on Emerging Technologies

Global Perspective

1. Informatics for adding value to information

The quantity of information now available to individuals and organizations is unprecedented in human history, and the rate of information generation continues to grow exponentially. Yet, the sheer volume of information is in danger of creating more noise than value, and as a result limiting its effective use. Innovations in *how information is organized, mined and processed* hold the key to filtering out the noise and using the growing wealth of global information to address emerging challenges.

Global Perspective

2. Synthetic biology and metabolic engineering

The natural world is a testament to the vast potential inherent in the genetic code at the core of all living organisms. Rapid advances in synthetic biology and metabolic engineering are allowing biologists and engineers to tap into this potential in unprecedented ways, enabling the development of new biological processes and organisms that are designed to serve specific purposes - whether converting biomass to chemicals, fuels and materials, producing new therapeutic drugs or protecting the body against harm.

Global Perspective

3. Green Revolution 2.0 - technologies for increased food and biomass

Artificial fertilizers are one of the main achievements of modern chemistry, enabling unprecedented increases in crop production yield. Yet, the growing global demand for healthy and nutritious food is threatening to outstrip energy, water and land resources. By integrating advances across the biological and physical sciences, the new green revolution holds the promise of further increasing crop production yields, minimizing environmental impact, reducing energy and water dependence, and decreasing the carbon footprint.

Global Perspective

7. Wireless power

Society is deeply reliant on electrically powered devices. Yet, a significant limitation in their continued development and utility is the need to be attached to the electricity grid by wire - either permanently or through frequent battery recharging. Emerging approaches to wireless power transmission will free electrical devices from having to be physically plugged in, and are poised to have as significant an impact on personal electronics as Wi-Fi had on Internet use.

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Combined Heat & Power

Micro-CHP Systems

- Combines internal–combustion engine generator or fuel cell with a space and/or water heating device.
- Produces heat and electricity
- Captures waste heat from the electric generation for space heating
- Suitable for residential and small commercial applications
- EPA estimates a typical home in a cold climate could reduce CO_2 emissions by 20–30%
- *2011-2012 ENERGY STAR Emerging Technology Award winners*

ECR International

Marathon ecopower

Waste to Energy

- On-site conversion of non-recyclable trash into electricity

- Gasification process – reaction of materials at high heat + oxygen or steam produces "syngas"

- Converts 95% waste into usable energy

- 3-4 year payback

Source: "Turn trash into energy in your office parking lot", Martin LaMonica, cnet
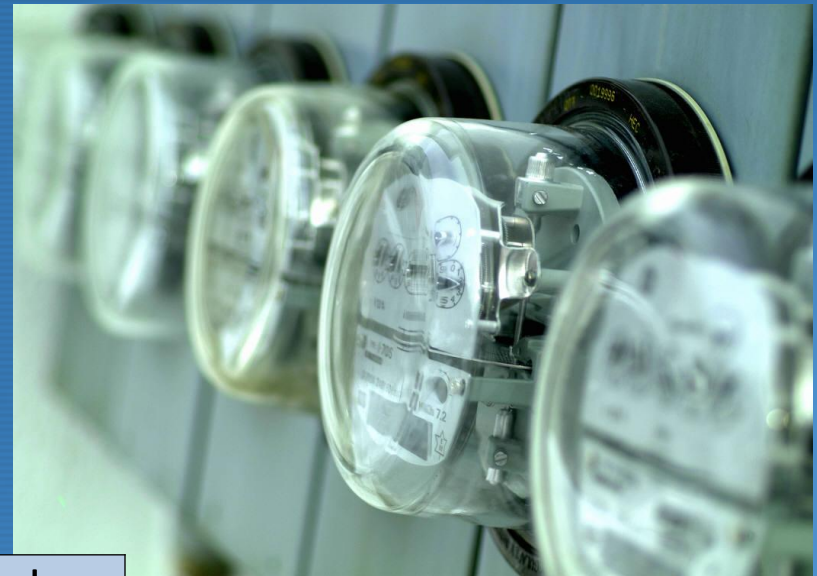
Equipment Controls

RTU Controller

- Optimizes outside air

- Connects economizer damper, fan, and compressor

- Demand-limiting capability

- Can interface with other systems

Metering

- **Where to meter**
- **How much to meter**
- **Types of metering**
- **Benefits**

Metering Action	Estimated Savings
Wireless meters	0-2%
Energy billing	2.5-5%
Measurement & verification	15-45%
Awareness	5-15%

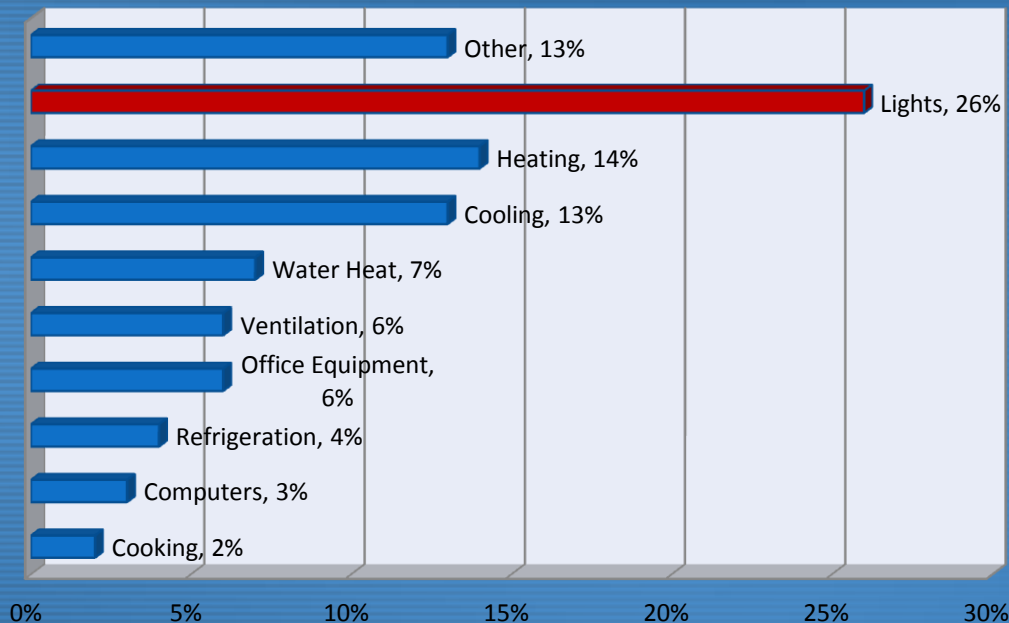*Data Source: Guidance for Electric Metering in Federal Buildings*

"Submetering provides the operations and maintenance transparency necessary to enable more efficient management of energy and water resources."

- Submetering of Building Energy and Water Usage, National Science and Technology Council Committee on Technology
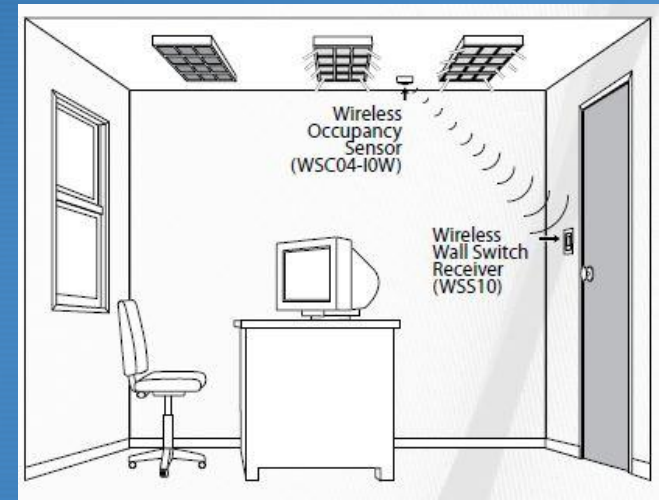
Wireless Lighting Controls

- **Flexibility**
- **Reduced installation cost**
- **Improved controllability**

Source: UC Berkeley, Center for the Built Environment

Commercial Buildings (18%)

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0% 5% 10% 15% 20% 25% 30%

Wireless Occupancy Sensor (WSC04-I0W)

Wireless Wall Switch Receiver (WSS10)

Source: Lighting Controls Association

Wireless Power

Current uses:

- **Device chargers**
- **Sensor power**

Future applications:

- **Wireless sensors in buildings**
- **Lighting**
- **Device controllers**

Summary

- Buildings - largest consumers of resources
- Key drivers for sustainability in the future: net zero and high performance goal
- Current requirements demand efficiency
- New technologies being developed

Resources

- *Guidance for Electric Metering in Federal Buildings* (DOE/EE-0312), February 3, 2006.

- *2010 Buildings Energy Data Book*, U.S. Department of Energy, www.buildingsdatabook.eren.doe.gov

- *Submetering of Energy and Water Usage, Analysis and Recommendations of the Subcommittee on Buildings Technology Research and Development*, National Science and Technology Council Committee on Technology, Subcommittee on Building Technology Reasearch and Development, October 2011.

- IFMA: www.ifma.org

- ENERGY STAR www.energystar.gov/buildings

Thanks!

Laurie Gilmer, P.E., CFM, SFP, LEED AP, CxA
Facility Engineering Associates

laurie.gilmer@feapc.com